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August 21, 2008

U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, D.C. 20555

Subject: Duke Energy Carolinas, LLC
McGuire Nuclear Station, Unit 1
Docket No. 50-369
Licensee Event Report 369/2008-02, Revision 0
Problem Investigation Process No.: M-08-03862

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report (LER) 369/2008-02, Revision 0, regarding the Unit 1 Reactor trip on June 26, 2008 due to the 1B Reactor Coolant Pump Motor trip which was caused by a failed surge capacitor.

This report is being submitted in accordance with 10 CFR 50.73 (a)(2)(iv)(A). This event is considered to be of no significance with respect to the health and safety of the public. There are no regulatory commitments contained in this LER.

If questions arise regarding this LER, contact Lee A. Hentz at 704-875-4187.

Very truly yours,

Bruce H. Hamilton

Attachment

IE22
NRR

cc: L. A. Reyes, Regional Administrator
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NRC FORM 366 (9-2007) U.S. NUCLEAR REGULATORY COMMISSION

# LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 08/31/2010
Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

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**4. TITLE**
Unit 1 Reactor Trip due to the 1B Reactor Coolant Pump Motor Trip which was caused by a failed Surge Capacitor

| 5. EVENT DATE | | | 6. LER NUMBER | | | 7. REPORT DATE | | | 8. OTHER FACILITIES INVOLVED | |
|---|---|---|---|---|---|---|---|---|---|---|
| MO | DAY | YEAR | YEAR | SEQUENTIAL NUMBER | REV NO | MO | DAY | YEAR | FACILITY NAME | DOCKET NUMBER |
| | | | | | | | | | None | 05000 |
| 06 | 26 | 2008 | 2008 | - 002 | 0 | 08 | 21 | 2008 | FACILITY NAME: None | DOCKET NUMBER: 05000 |

**9. OPERATING MODE**
1

**10. POWER LEVEL**
100

**11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §:** *(Check all that apply)*

| | | | |
|---|---|---|---|
| 20.2201(b) | 20.2203(a)(3)(i) | 50.73(a)(2)(i)(C) | 50.73(a)(2)(vii) |
| 20.2201(d) | 20.2203(a)(3)(ii) | 50.73(a)(2)(ii)(A) | 50.73(a)(2)(viii)(A) |
| 20.2203(a)(1) | 20.2203(a)(4) | 50.73(a)(2)(ii)(B) | 50.73(a)(2)(viii)(B) |
| 20.2203(a)(2)(i) | 50.36(c)(1)(i)(A) | 50.73(a)(2)(iii) | 50.73(a)(2)(ix)(A) |
| 20.2203(a)(2)(ii) | 50.36(c)(1)(ii)(A) | X 50.73(a)(2)(iv)(A) | 50.73(a)(2)(x) |
| 20.2203(a)(2)(iii) | 50.36(c)(2) | 50.73(a)(2)(v)(A) | 73.71(a)(4) |
| 20.2203(a)(2)(iv) | 50.46(a)(3)(ii) | 50.73(a)(2)(v)(B) | 73.71(a)(5) |
| 20.2203(a)(2)(v) | 50.73(a)(2)(i)(A) | 50.73(a)(2)(v)(C) | OTHER |
| 20.2203(a)(2)(vi) | 50.73(a)(2)(i)(B) | 50.73(a)(2)(v)(D) | Specify in Abstract below or in NRC Form 366A |

**12. LICENSEE CONTACT FOR THIS LER**

| FACILITY NAME | TELEPHONE NUMBER (Include Area Code) |
|---|---|
| Lee A. Hentz, Regulatory Compliance | 704-875-4187 |

**13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT**

| CAUSE | SYSTEM | COMPONENT | MANU-FACTURER | REPORTABLE TO EPIX | CAUSE | SYSTEM | COMPONENT | MANU-FACTURER | REPORTABLE TO EPIX |
|---|---|---|---|---|---|---|---|---|---|
| B6 | EA | CAP | W120 | Y | | | | | |

| 14. SUPPLEMENTAL REPORT EXPECTED | | | 15. EXPECTED SUBMISSION DATE | MONTH | DAY | YEAR |
|---|---|---|---|---|---|---|
| YES (If yes, complete EXPECTED SUBMISSION DATE) | X | NO | | | | |

**16. ABSTRACT** (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

**Unit Status**: At the time of the event Unit 1 and 2 were in Mode 1 at 100% power.

**Event Description**: On June 26, 2008, the 1B Reactor Coolant (NC) pump motor tripped when the 6900 Volt feeder and safety breaker over-current protective relays sensed a ground fault which in turn caused a Unit 1 Reactor trip due to low NC system flow sensed by the Reactor Protection system. Unit 1 returned to Mode 1 on June 29, 2008. This event is considered to be of no significance with respect to the health and safety of the public.

**Event Cause**: Electrical testing determined an NC pump motor surge capacitor had shorted to ground. The cause of the failed surge capacitor was determined to be improper design.

**Corrective Actions**: The failed surge capacitor was replaced. Replace all the Unit 1 NC pump motor surge capacitors during the Fall 2008 refueling outage. Replace all existing surge capacitors with a more robust design. Perform a detailed electrical system analysis to determine if NC pump motor surge capacitors can be eliminated.

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**17. NARRATIVE** *(If more space is required, use additional copies of NRC Form 366A)*

BACKGROUND

The following information is provided to assist readers in understanding the event described in this LER. Applicable Energy Industry Identification [EIIS] system and component codes are enclosed within brackets. McGuire unique system and component identifiers are contained within parentheses.

Reactor Coolant System [AB](NC):

The reactor coolant (NC) system consists of four heat transfer loops connected to the Reactor Vessel [AB-RPV]. Each loop contains an NC pump [AB-P], Steam Generator [AB-SG] and associated piping and valves. In addition, the system includes a Pressurizer [AB-PZR], interconnecting piping and instrumentation necessary for operational control. NC system pressure is controlled by the use of the Pressurizer where water and steam are maintained in equilibrium by electrical heaters or water sprays. Steam can be formed by heaters or condensed by Pressurizer spray to minimize pressure variations due to contraction and expansion of the NC system.

Reactor Protection System [JC](IPE):

The Reactor Protection System keeps the Reactor operating within a safe operating range by automatically shutting down the Reactor whenever the limits of the operating range are approached by monitoring process variables. Whenever a direct or calculated process variable exceeds a setpoint the Reactor is automatically tripped to protect against fuel cladding damage or loss of NC system integrity. Above approximately 48% Reactor thermal power (P-8), low NC system flow in one of the four loops will cause a Reactor trip.

6900 Volt Switchgear Relaying [EA](EPB):

The NC pump motor [AB-MO] 6900 Volt switchgear feeder and redundant safety breakers [EA-52] have overcurrent phase and ground fault protection. Phase relays 50 and 51 [EA-95] protect the pump motor from overloads and phase to phase faults. The ground relay 50G [EA-64] protects the pump motor from phase to ground faults. These overcurrent relays monitor current from Current Transformers [EA-ICT] located on the motor side of the safety breaker and initiate a pump motor breaker trip when they sense faults.

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Each NC pump motor is provided with three oil filled surge capacitors [EA-CAP], one per phase. The NC pump motor is a critical duty machine which can be subjected to steep voltage surges resulting from switching operations, buss transfers and other transient conditions. The surge capacitors reduce the rate of rise of an incoming voltage surge which substantially reduces the voltage stress to the motor stator turn insulation. Per the motor manufacturer, Westinghouse, surge capacitors are not required for safe operation but recommended on motors designed for them.

Prior to this event Unit 1 was operating at 100% power with no safety systems or components out of service that would have contributed to this event.

EVENT DESCRIPTION

On June 26, 2008, with Unit 1 operating at 100 % power, the 1B NC pump motor tripped when the 6900 Volt feeder and safety breaker overcurrent protective relays (50G) sensed a ground fault which in turn caused a Reactor trip due to low NC system flow sensed by the Reactor Protection System. This event is reportable under 10 CFR 50.73(a)(2)(iv)(A) as a valid automatic actuation of the Reactor Protection System and Auxiliary Feedwater System.

The relevant sequence of events is as follows (all times approximate):

- At 1731 on June 26, 2008, the 1B NC pump motor tripped on the 50G ground fault relay sensed by both the 6900 Volt feeder and safety breakers. A neutral overcurrent alarm was also received on transformer 1ATB [EL-XFMR](EPA).

- At 1731 the Unit 1 Reactor tripped due to low NC system flow in one loop above P-8. The Unit 1 Main Turbine [SB-TRB](SM) also tripped as expected.

- At 1731 Operations personnel entered procedure EP/1/A/5000/E-0, Reactor Trip or Safety Injection, and then transitioned to EP/1/A/5000/ES-0.1, Reactor Trip Response.

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- At 1732 Main Feedwater system [SJ](CF) isolation occurred due to the Reactor trip and a low NC system loop average temperature (Tave) signal. Both motor driven and turbine driven Auxiliary Feedwater pumps [BA-P](CA) started on low-low Steam Generator levels. Additional details are provided at the end of the sequence of events.

- At 1810 Operations personnel made the required NRC immediate notification pursuant to 10 CFR 50.72(b)(2)(iv)(B) and 50.72(b)(3)(iv)(A) due to a valid actuation of the Reactor Protection System and Auxiliary Feedwater System.

- At 1850 the Main Feedwater system was restored and the Auxiliary Feedwater pumps were returned to standby readiness.

- On June 27, once the plant was stabilized, a ground was confirmed on the 1B NC pump motor surge capacitor [EA-CAP] Z phase by a Meggar test. A capacitance check of the failed surge capacitor also confirmed it had faulted to ground. Other components in the NC pump motor circuit were electrically tested with satisfactory results including the motor, connectors, cables, capacitors, relays, and the penetrations.

- On June 27, Maintenance personnel replaced the failed surge capacitor.

- On June 28 at 0900, a Plant Operating Review Committee (PORC) meeting was held to discuss the Unit 1 restart. The PORC approved the decision to restart Unit 1.

- On June 29 at 1305, the 1B NC pump motor was started. All indications were normal.

- On June 29 at 2027, Unit 1 was returned to Mode 1.

The 1B NC pump motor trip allowed the B NC system loop flow to change directions, enabling a sequence of events that resulted in a NC system low Tave signal and Main Feedwater (CF) system isolation. The normal B loop flow direction directs flow past the Pressurizer surge line to the B loop Steam Generator without affecting the B loop hot leg temperature indication.

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Following the Reactor trip, a Pressurizer outsurge occurred while Pressurizer level was decreasing. With the B loop flow reversed, hot Pressurizer liquid outsurge traveled toward the Reactor Vessel, impacting the B loop hot leg and Tave temperature indications. At this point in the event, the Steam Dump system [JI](SB) was in the Tave control mode. The Steam Dumps responded appropriately to the increasing temperature indication by opening which further cooled the NC system. The cooling of the NC system caused additional Pressurizer outsurge and cooling. This is a self limiting positive feedback loop, which terminated when the low Tave signal was reached on the other 3 NC system loops and blocked the steam dumps from opening again. This phenomenon would not have occurred if an NC pump motor had tripped on any of the other three NC system loops. The Pressurizer surge line is connected to the B NC system loop. At no time was the NC system overcooled nor was a safety injection initiated.

CAUSAL FACTORS

The cause of the failed surge capacitor was determined to be improper design that could result in reduced service life. However, an additional cause of manufacturing defect/deficiency has not been eliminated. Independent laboratory analysis is currently being performed. Should the results significantly affect the cause or corrective actions, the LER will be revised accordingly.

The surge capacitor design incorporates lead shielding inside the enclosure that completely wraps the capacitor internal parts to provide radiation protection. The lead shielding can cause several failure modes such as:

- Electrical short circuits due to lead particles
- Electrical short circuits due to abrasive polypropylene breakdown due to lead particles
- Blocked oil flow due to enclosure restrictions or lead particles
- Suppression of heat dissipation due to the lead shielding.

One of these conditions or a combination of these conditions resulted in degradation of the surge capacitor dielectric properties that eventually resulted in a short to ground.

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CORRECTIVE ACTIONS

Immediate:

1. Operations personnel entered procedure EP/1/A/5000/E-0, Reactor Trip or Safety Injection, and then transitioned to EP/1/A/5000/ES-0.1, Reactor Trip Response.

Subsequent:

1. Electrical testing confirmed the 1B NC pump motor surge capacitor Z phase had faulted to ground and failed. Other components in the pump motor circuit were electrically tested with satisfactory results including the motor, connectors, cables, capacitors, relays, and the penetrations.

2. Maintenance personnel replaced the failed surge capacitor.

Planned:

1. Replace the Unit 1 NC pump motor surge capacitors during the Fall 2008 refueling outage so that thorough testing and analysis of the removed surge capacitors can be performed.

2. Evaluate test data obtained from the surge capacitors removed during the Unit 1 Fall 2008 refueling outage to determine if additional interim actions are required for both Units before a more robust design is developed and installed.

3. Replace the existing NC pump motor surge capacitors with a more robust design with increased design margin with respect to temperature, voltage, & vibration. Also, the new design specifications should consider removal of the lead shielding from inside the surge capacitor canister.

4. Perform a detailed analysis of the McGuire electrical distribution system in order to determine if the NC pump motor surge capacitors can be eliminated or determine an alternate surge suppression device.

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SAFETY ANALYSIS

Duke Energy used a risk informed approach to determine the risk significance associated with the Reactor trip of June 26, 2008. Prior to the trip, no risk significant plant equipment was out of service. During the event, the unit experienced an automatic Reactor trip and actuation of the Auxiliary Feedwater system (CA) due to a Main Feedwater system isolation. Feedwater flow to the Steam Generators was maintained by the CA system ensuring adequate decay heat removal. Following the trip, other plant equipment needed for mitigating the event remained available.

The Conditional Core Damage Probability (CCDP) of this event was evaluated quantitatively by considering the following:

- A Reactor trip initiating event
- Actual plant configuration and maintenance activities at the time of the trip

The CCDP was calculated to be approximately 3E-07. The Conditional Large Early Release Probability (CLERP) associated with this event was calculated to be approximately 1E-08. These values are much less than the respective threshold values of 1E-06 and 1E-07 for an accident sequence precursor event.

Given the above, this event is considered to be of no significance with respect to the health and safety of the public.

ADDITIONAL INFORMATION

McGuire has experienced two previous occurrences of NC pump motor surge capacitor failures resulting in NC pump motor and Reactor trips in 1987 and 1995 as documented in LERs 369-1987-04 and 369-1995-06. These surge capacitors were of the original ceramic type design.

In 1999, due to obsolescence issues, Westinghouse provided a replacement surge capacitor of the oil filled design. The Unit 1 surge capacitors were replaced with the oil filled design during the September 2005 Unit 1 refueling outage. The 2A and 2C NC pump motor surge capacitors were replaced during the March 2005 Unit 2 refueling outage. The 2B and 2D NC pump motor surge capacitors were replaced during the September 2006 Unit 2 refueling outage.

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Some plants have replaced the surge capacitors with other voltage limiting devices, while others have evaluated the electrical system and removed the surge capacitors. Surge capacitor removal is not performed without extensive system analysis and electrical system measurements that substantiate the calculations.

This event is not considered to be recurring because this was McGuire's initial failure of the oil filled surge capacitor design.